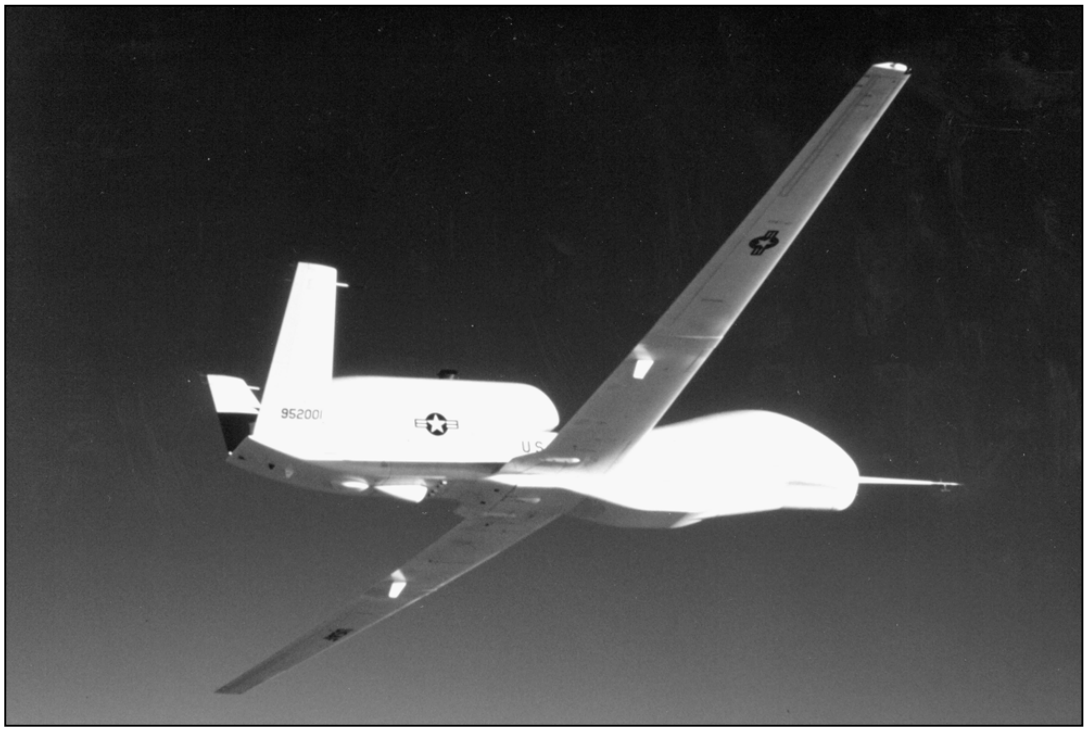
RQ-4A GLOBAL HAWK UNMANNED AERIAL VEHICLE (UAV) SYSTEMS



Air Force Program

Total Number of Systems	
Global Hawk Air Vehicles:	78
Common Ground Segments:	16
Total Program Cost (TY$):	$1.55B (FY01-07)
Average Unit Production Cost (TY$):	$55M (per air vehicle & 25% cost of ground segment)
MS II Production Review:	2QFY01

Prime Contractor

Northrop Grumman (air vehicle)
Ryan E-systems (ground segment)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Global Hawk Unmanned Aerial Vehicle (UAV) system is a theater commander's asset to satisfy broad area coverage and deep target surveillance and reconnaissance shortfalls. The Global Hawk air vehicle is to provide high resolution Synthetic Aperture Radar (SAR) and Electro-Optical/Infrared (EO/IR) imagery at long range with long loiter times over target areas. Potential missions for the Global Hawk cover the spectrum of intelligence collection capability to support joint combatant forces in worldwide peace, crisis, and wartime operations. These systems will support the in-theater CINC in ***precision engagement and full-dimensional protection through information superiority***.

The Global Hawk UAV system comprises an air vehicle segment consisting of air vehicles with sensor payloads, avionics, and data links; a ground segment consisting of a Launch and Recovery

Element (LRE), and a Mission Control Element (MCE) with embedded ground communications equipment; a support element; and trained personnel.

The Global Hawk air vehicle is optimized for long range and endurance; it should be capable of providing 24 hours on-station at a 1,200-nautical mile range from the launch site. It has a wingspan of 116 feet and length of 44 feet, and has a cruise speed of 350 knots. The maximum operating altitude is 65,000 feet mean sea level, although it is capable of providing imagery once above 56,000 feet above ground level.

The Integrated Sensor Suite (ISS) consists of a synthetic aperture radar (SAR), electro-optical (EO), and infrared (IR) sensors. Either the EO or the IR sensors can operate simultaneously with the SAR. Each of the sensors provides wide area search imagery and a high-resolution spot mode. The SAR has a ground moving target indicator (GMTI) mode. GMTI data are transmitted as a text product providing moving target location and radial velocity. Both SAR and EO/IR imagery are processed onboard the aircraft and transmitted to the MCE as individual frames. The MCE can mosaic these frames into images prior to further dissemination.

Navigation is via inertial navigation with integrated Global Positioning System updates. Global Hawk is intended to operate autonomously and "untethered" using a satellite data link (either Ku or UHF) for sending sensor data from the aircraft to the MCE. The common data link can also be used for direct down link of imagery when the UAV is operating within line-of-sight of users with compatible ground stations.

The ground segment consists of an MCE for mission planning, command and control, and image processing and dissemination; an LRE for controlling launch and recovery; and associated ground support equipment. (The LRE provides precision differential global positioning system corrections for navigational accuracy during takeoff and landings, while precision coded GPS supplemented with an inertial navigation system is used during mission execution.) By having separable elements in the ground segment, the MCE and the LRE can operate in geographically separate locations, and the MCE can be deployed with the supported command's primary exploitation site. Both ground segments are contained in military shelters with external antennas for line-of-sight and satellite communications with the air vehicles.

BACKGROUND INFORMATION

The Global Hawk program began as part of the High Altitude Endurance (HAE) Advanced Concept Technology Demonstration (ACTD), which included both the Global Hawk and the Dark Star UAV programs. The ACTD began in 1995 under Defense Advanced Research Projects Agency management, and in October 1998 transitioned to the Air Force systems program office at Wright Patterson AFB. The Dark Star program was cancelled in January 1999. The Global Hawk portion of the ACTD was conducted in three phases: design; development and test; and deployment and evaluation. The deployment and evaluation phase was conducted between June 1999-June 2000, with the U.S. Joint Forces Command as the operational sponsor. At the conclusion of the ACTD, USJFCOM declared the Global Hawk had military utility and submitted a military utility assessment in September 2000 to support the transition from an ACTD to an acquisition program.

In August 1999, OSD issued an Intelligence Program Decision Memorandum directing the Air Force to initiate an acquisition program with a Milestone II decision at the end of the FY00. The Air Force subsequently developed an acquisition strategy that is based on a spiral development process

leading to Global Hawk air vehicles that satisfy the needs identified in the Military Utility Assessment and validated in the Operational Requirements Document in separate block configurations. The desired operational requirements were prioritized and each spiral will include those upgrades that available funding can afford. The full operational capability identified by the Air Force in the ORD will not be available until the second spiral or Block 10 systems are produced.

Five Global Hawk air vehicles were produced and delivered to Edwards AFB during the ACTD, and two more are under contract. Once the additional air vehicles and payloads are delivered, four air vehicles, two mission control elements, three launch and recovery elements, two SAR payloads, and one integrated sensor suite (with EO/IR and SAR) will be residual assets from the ACTD.

Global Hawk had its first flight in February 1998, and completed 58 sorties totaling 719.4 flight hours throughout the ACTD period. A crash in March 1999 destroyed air vehicle Number 2 and its sensor suite, and a runway incident in December 1999 damaged air vehicle Number 3 and destroyed the only other integrated sensor suite. Consequently, no EO/IR imagery was available during any warfighting exercises. A separate SAR sensor provided imagery.

Following the runway incident in December 1999, the Air Force Flight Test Center took over responsibility of flight safety and grounded the system until March 2000. As a result, participation in five out of the final seven planned exercises was cancelled. This is significant because these seven exercises were to be the core of the military utility assessment.

Due to the nature of an ACTD program, documentation capturing the requirements, operations, and testing strategy have been necessarily conducted along parallel paths. Prior to the Milestone review and approval authority to enter EMD and LRIP, however, four key elements must be available: a JROC-approved ORD, a Service-approved CONOPS, an Acquisition Strategy, and a TEMP. This documentation is necessary to provide the warfighter with the most effective and suitable system possible.

TEST & EVALUATION ACTIVITY

The year-long demonstration and evaluation phase for military utility assessment (June 1999–June 2000) was conducted with a “crawl, walk, run” approach, beginning as a non-obtrusive participant in exercises with a gradual increase in importance as an exercise participant, finishing with full integration into the theater collection and operations infrastructure. Between October-November 1999, the program continued the walk phase by participating in extended range missions (ER 3 and 4) over many western training ranges in California, Nevada, Idaho, and Utah. ER 4 was the first over-water flight and also included operations over the Cope Thunder ranges in Alaska. The final two exercises in the walk phase were the Joint Task Force Exercise-West including maritime, littoral, and inland operations, and the Combined Joint Task Force-Six (CJTF-6) along the U.S. Mexican border.

A runway incident in early December 1999 destroyed the second and only available Integrated Sensor Suite (ISS), the system was grounded until March while the Air Force Flight Test Center reviewed all safety procedures. (The first ISS was destroyed when AV-02 crashed in March 1999.)

Flight-testing resumed in March with AV-01; and in April, an LRE deployed to Eglin AFB, FL while the Mission Control Element deployed to Suffolk, VA. AV-04 self-deployed on a flight from Edwards AFB, California to Eglin AFB. Participation in two exercises, Linked Seas and JTFEX-00, occurred during this deployment. The entire system re-deployed to Edwards AFB in June 2000.

Flight testing of AV-05 began on June 30, 2000.

TEST & EVALUATION ASSESSMENT

The walk phase included participation in four exercises in a three-month period between October and December 1999. During all exercises, the Global Hawk launched from and landed at Edwards AFB, and the missions were monitored via the MCE at the contractor's facility in San Diego, CA. Operations took place over several western training ranges in California, Nevada, Idaho, Utah, Alaska, Arizona, and along the U.S.-Mexican border. Throughout the walk phase, six sorties were flown to completion, three were cancelled, and three had air aborts. The first two exercises (four sorties) were conducted with AV-01 and a SAR sensor. The second two exercises (five sorties) were conducted with AV-03 and a full ISS (EO/IR/SAR). Only SAR imagery was disseminated during any exercises; the EO/IR sensor was still undergoing engineering evaluation prior to being destroyed during the runway incident in December. New accomplishments of the Global Hawk during the walk phase included over-water operations, operations above 65 degrees north latitude, and direct down link of imagery to a JSIPS-N at Fallon, NV. However, the Global Hawk was never fully integrated into any exercise or training scenario during this phase, and this limited the ability to collect data on military utility or effectiveness. Except for the direct down link demonstration at Fallon, imagery was typically transmitted to the MCE and then re-transmitted to multiple user sites. Some imagery was also disseminated via the Global Broadcast System (GBS) to the USS Coronado, although those images had to be chipped from their full 80 megabytes to 6-megabyte chips.

The run phase consisted of a deployment to Eglin AFB, participation in two exercises, Linked Seas and JTFEX-00, and a re-deployment to Edwards AFB. On April 20, 2000, AV-04 flew a 10.5-hour flight from Edwards AFB to Eglin AFB. During this flight some pre-planned imagery orbits were cancelled because of a low temperature anomaly that necessitated an early landing. Subsequently, Global Hawk AV-04 flew two sorties in support of Linked Seas. Both sorties were planned to provide imagery of littoral areas near Portugal after making the transatlantic flight and then to return to Eglin AFB. The first sortie lasted 28 hours and accomplished the first trans-oceanic flight of Global Hawk, including operations in international air space. During the initial part of the flight, SAR imagery was transmitted from the MCE to Ft. Bragg, but attempts to direct down link to the USS George Washington were unsuccessful. Once in theater, none of the Portuguese scenes on the collection plan were collected because of a SAR transmitter failure; one re-task scene from Portugal was captured although image quality was reported as poor. The second Linked Seas sortie lasted 14.1 hours. Problems communicating with the UHF satellite precluded the trans-oceanic portion of the mission. SAR imagery was collected along the U.S. East Coast, and three scenes were transmitted via direct down link to the USS George Washington.

The Global Hawk flew two sorties in support of JTFEX-00: the first lasted 22.5 hours and the second lasted 14.7 hours. Imagery was collected and disseminated via direct down link to the USS George Washington and the Army TES at Cherry Point, NC. GBS dissemination during JTFEX was not successful. During the second sortie, a mission computer failure necessitated an early landing. The air vehicle remained at Eglin for about a month until the problem was found and fixed; on June 19, 2000

AV-04 re-deployed to Edwards AFB. Due to problems with the sensor and mission computer interface, no imagery was taken during that flight.

After the re-deployment, the remaining scheduled exercises in the run phase, including a Canadian exercise, were cancelled because of technical issues associated with the verification and validation of the mission planning software.

Throughout the ACTD, system maintenance and operations depended heavily on development contractors. The only military operators and maintainers familiar with Global Hawk are part of the 31st Test and Evaluation Squadron. No operational squadron or home base has yet been identified for the Global Hawk.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The accelerated nature of an ACTD program makes syncing the test and acquisition strategy more difficult than in a traditional program. For Global Hawk, DOT&E worked with the System Program Office and the Air Force test and evaluation community to establish a credible test strategy to support the Milestone II decisions to enter EMD. In this case, the several block upgrades comprising the first spiral will not meet the full requirements from the user, making assessments of operational effectiveness and suitability difficult. However, DOT&E is working, through the IPT process, to establish meaningful thresholds for the initial block systems.

Another result of the ACTD process is the availability of residual assets for test, exercise participation, and real-world deployments. Careful planning is necessary to ensure that enough assets are available so that residual operations and development and testing can occur simultaneously.